REMARKS

Amendments to the Specification

The amendments to paragraph **[0001]** of the specification insert the serial number of the related case as suggested by the Examiner in paragraph 1 of the Office Action. The amendments to paragraphs **[0057]** and **[0063]** correct typographical errors in the paragraphs.

Amendments to the Claims

Claim 1 is amended to replace the term "surface" with the word "substrate". Support for the amendment is found in paragraph **[0007]**, which notes that a source of contamination is from "wafers . . . that may leech contaminants during the manufacturing and photolithography process." Thus, methods of the invention may remove contaminants that are not just on a surface. Also, Example 5, paragraphs **[0053]** – **[0060]**, describes results of an experiment which decontaminates different types of diaphragm valves. Specifically, paragraph **[0054]** states that "hydrocarbon contamination [is] generated by outgassing from elastomeric components in the valves." Thus, methods of the invention may decontaminate substrates that outgas contaminants, regardless of the physical location of the contaminants. Amendments to claims 8, 12, and 18 also replace the term "surface" with the word "substrate", support provided as enunciated above.

Claim 1 is also amended to replace the step of "purifying a purge gas" with "providing a purified purge gas." Support for the amendment is present in Examples 1-6 of the application, which utilize various purified purge gases to remove airborne molecular contaminants (AMC) from a substrate without requiring that the actual purification of the purge gases take place as part of the AMC removal method. Claim 12 is similarly amended and supported.

Claim 1 is further amended to provide the limitation that the substrate is "contaminated with AMC before the substrate is contacted with purified purge gas." Support for the amendment is found in the numerous examples of the application which utilize the apparatus of FIG. 4. In particular, as described in paragraph **[0044]**, "a hydrocarbon mixture [] contaminate[s] the surfaces of a test device." Subsequently, purge gas "created by system 100 [is] directed to the device under test (DUT) 402. The hydrocarbon concentrations leaving the DUT 402 are introduced into the input 122 of the gas chromatography gas analysis system 120, where the hydrocarbon levels can be measured." Thus, a contaminant species measured by the gas chromatograph can be the same contaminant species that contaminates the substrate before purge gas is introduced, in various examples of the application.

Claims 2-5, 8-11, 13-15, 18, and 19 are also amended to provide clearer language, correct typographical errors, and correct a spelling error. With respect to Claims 8, 9, 18, and 19, support for the amendments may be found in the description of FIG. 5 at paragraph **[0046]**, and the various examples of the application. The Amendments to Claims 10 and 11 should obviate the rejection thereof under 35 U.S.C. §112, second paragraph.

Prior Art Rejections

A. Independent Claim 1

Amended claim 1 is drawn to "[a] method for the removal of airborne molecular contaminants (AMC) from a substrate." The substrate is "contaminated with AMC before the substrate is contacted with a purified purge gas." The purified purge gas, comprising oxygen and having an AMC concentration less than about 1 part per billion (ppb), contacts the substrate. A contaminated purge gas with the AMC is subsequently produced and removed, thus removing the AMC from the substrate.

Claim 1 is rejected under 35 U.S.C. §103(a) as being obvious in light of a combination of Somekh (U.S. Patent No. 6,427,703) and Alvarez Jr. *et al.* (U.S. Patent No. 6,391,090). Amended Claim 1, however, is patentable because each of the prima facie elements of obviousness cannot be constructed. In particular, the combination of Somekh and Alvarez do not teach all the necessary elements of the claim; no reasonable expectation of success exists to combine the references even if the necessary elements existed; and no motivation exists to combine Somekh and Alvarez. Each of these reasons independently compels a finding of nonobviousness.

1. Somekh and Alvarez do not teach removing contaminants from a substrate contaminated with AMC before purified purge gas contacts the substrate

Neither Somekh or Alvarez teach a necessary element of claim 1: removing airborne molecular contaminants (AMC) from a substrate that is contaminated with AMC before the substrate is contacted with purified purge gas.

Somekh is drawn to methods and devices for oxidizing carbon contaminants into volatile gases that are subsequently evacuated from a lithography system chamber. As described by Somekh, oxidizer "is introduced into the imaging chamber . . . to oxidize any carbon contaminants that may be present . . ." (column 8, lines 60-61). "The oxidation process *transforms* any carbon residue that is in solid form to a gaseous form" (column 8, lines 63-65). "The oxidized carbon gas is a volatile gas species that can be evacuated . . . to thereby remove the *oxidized* carbon contaminants" (column 9, lines 6).

Thus, Somekh teaches the removal of a residue on a mask or chamber wall by transforming the residue by oxidation to a gas, and removing the gas. The substrate in Claim 1 is "contaminated with AMC *before* the substrate is contacted with purified purge gas." The method also "transfer[s] the AMC from the substrate into the purified purge gas." Somekh, in contradistinction, has a surface contaminated with carbon deposits before the oxidizer is introduced. The surface is not originally contaminated with the gas that is eventually removed. Somekh does not teach the element of Claim 1.

Alvarez also does not teach the necessary limitation of Claim 1. Alvarez teaches methods of decontaminating a gas for use in photolithography and metrology. Alvarez notes the detrimental impact of contaminated gases in photolithography and metrology applications. Thus, the methods of Alvarez may be used to *prevent* contamination by utilizing purified gases produced by the methods taught therein. Alvarez does not discuss methods of removing contaminants from substrates that are already contaminated. And particularly, Alvarez does not discuss a method of removing contaminants from a substrate in which the substrate is "contaminated with AMC before the substrate is contacted with purified purge gas," as set forth in Claim 1.

Since neither Alvarez or Somekh teach a necessary limitation of Claim 1, they cannot render Claim 1 obvious. Thus, Claim 1 is patentable over the combination.

2. *Contemporary art explicitly indicates no reasonable expectation of success using oxygen in a purge gas to remove substrate contaminants*

Even if all the elements of Claim 1 were taught by Somekh and Alvarez, Claim 1 is still nonobvious because no reasonable expectation of success existed to practice the claim in light of the understanding of the contemporary art.

As reported by Velleroit *et al.* in Micromagzine.com in August 2003 (a copy of the article is attached in the accompanying IDS being filed herewith), purge gases utilized to attempt to clean semiconductor surfaces actually resulted in an increase in contamination of surfaces (see Figures 4 and 7, and conclusion of page 8). In the tests, the purge air was contaminated by organics at a level below 2 ppb (see page 3). Thus, the use of oxygen in a purge gas to lower substrate contamination was not obvious to those skilled in the art.

In contradistinction, the current application provides numerous examples where extra clean dry air is used to decontaminate surfaces (see Examples 1-3). Thus, the current application provides new teachings suggesting that a purge gas comprising oxygen can decontaminate a substrate. Without the specific teachings of the application, no reasonable expectation of success exists to practice Claim 1.

3. *No Motivation Exists to Combine Somekh and Alvarez because they are directed to different problems*

No motivation exists to combine Somekh and Alvarez to teach the claimed method because the references are motivated by distinct situations: removing existing contamination versus preventing contamination.

Somekh is directed toward removing *existing carbon contamination* on a lithography tool surface or mask by introducing an oxidizer gas to transform the carbon contamination into a volatile gas that is subsequently removed. Alvarez teaches *preventing contamination* in photolithography and metrology systems by using purified gases a priori. Thus, the two references point to different decontamination schemes.

The two references may suggest using purified gases *before* carbon deposits form on a surface. But there is no motivation to utilize a purified oxidizer gas in Somekh *after* a surface is contaminated. The oxidizer gas merely requires an oxidizer to transform the preexisting carbon contaminants; there is no suggestion whatsoever that the purity of the oxidizer gas impacts the ability to remove carbon deposits. Certainly, there is no motivation or suggestion that the oxidizer gas be purified to "an AMC concentration less than 1 ppb" as stated in Claim 1. Thus, no motivation exists in the references to apply Alvarez's methods for generating purified gases to the oxidizer gas in Somekh's method.

Without a motivation to combine Somekh and Alvarez, a prima facie case of obviousness against Claim 1 cannot be sustained.

For each of the foregoing reasons, Claim 1 is not obvious in light of Somekh and Alvarez.

B. Dependent Claims 2-11

Claims 2-11 ultimately depend from Claim 1. Thus, Claims 2-11 are also patentable for substantially the same reasons that Claim 1 is patentable. In particular, Claims 10 and 11 are nonobvious over the combination of Somekh, Alvarez, and Van Schaik *et al.* (U.S. Patent No. 6,724,460) regardless of whether Van Schaik teaches purging with an inert gas.

Van Schaik actually teaches away from the claimed invention. With regard to using oxygen-containing species in a purge gas, the reference states that "these materials themselves are not effective as cleaning agents" without using UV radiation (column 4, lines 15-17). Thus, one would not utilize Van Schaik with Somekh and Alvarez to teach any of the claimed methods of removing contaminants from a substrate using a purge gas that includes oxygen.

Furthermore, Claim 9 is patentable because Somekh and Alvarez, do not teach the additional feature of removing AMC from a silicon substrate. Somekh only discloses using oxidation to remove "carbon deposits on mask and imaging chamber surfaces" (column 3, lines 16-20). Thus, Somekh is directed toward cleaning a tool, and not silicon substrates that may be used in semiconductor devices. Alvarez also discusses using its gas purification embodiments to produce clean lens gases to prevent contamination of optical tools. Alvarez does not discuss purge gases that are used to remove AMC from a silicon substrate. Thus, the combination lacks the necessary elements of Claim 9.

C. Independent Claim 12

Amended Claim 12 is drawn to "[a] method for the removal of airborne molecular contaminants (AMC) from a substrate." Purified purge gas, comprising oxygen at a concentration between about 1% and about 25% on a volume basis and having an AMC concentration less than about 1 part per billion (ppb), contacts the substrate. A contaminated purge gas with the AMC is subsequently produced and removed, thus removing the AMC from the substrate.

Claim 12 stands rejected as obvious over a combination of Alvarez, Somekh, and Straaijer (U.S. Patent No. 5,602,683). Somekh and Alvarez fail to teach the oxygen concentration required in Claim 12 (see Office Action, item 9). Thus, the Office Action relies on Straaijer to provide the necessary oxygen concentration teaching (see id.).

Straaijer, however, teaches directly away from Claim 12. Straaijer is drawn to bathing a lens system in ozone to prevent lens system contamination, not to removing contaminants from a substrate as required by Claim 12. Specifically with regard to using oxygen to remove contaminants that are already deposited on a substrate, Straaijer explicitly states that "[i]t is *not possible* to clean an already contaminated lens system by rinsing it in air or oxygen" (column 2, lines 27-28).

Straaijer specifically discourages the use of oxygen in any concentration, including the concentrations used in its teachings to produce ozone, to practice the method of Claim 12. Therefore, one of ordinary skill in the art would not combine the teachings of Alvarez, Somekh, and Straaijer to teach Claim 12.

In contradistinction, numerous examples in the application show the benefits of using a purge gas having oxygen in the concentration range called out in Claim 12 (see Examples 1-3 for some instances).

Thus, the application provides an unexpected result that contradicts the discouragement explicitly indicated in Straaijer. Claim 12 is both nonobvious and patentable.

D. Dependent Claims 13-19

Claims 13-19 ultimately depend from independent Claim 12. Thus, the dependent claims are patentable for substantially the same reasons that Claim 12 is patentable. Furthermore, Claim

19 is patentable for the reasons that Claim 9 is patentable. Indeed, Straaijer provides no further teaching toward removing AMC from silicon substrates since the reference is only concerned with preventing contamination on lens surfaces.

E. New Claims

New Claims 20-26 are presented for entry into the application.

Support for Claims 20 and 24 is present in paragraph **[0039]**, stating that "[p]urge gases are typically inert." Paragraph **[0039]** describes the potential mechanism by which contaminants are removed by an equilibrium driving force. Paragraph **[0040]** describes the potential mechanism of removal by a kinetic effect. Paragraph **[0041]** describes the potential mechanism of removal by a chemical effect solely between the purge gas and a surface. Thus, under such circumstances, the purge gas is inert with respect to the contaminant.

Claims 20 and 24 are patentable over the cited art because none of the references teaches using a purified purge gas that is inert with respect to the AMC. To the extent that Somekh, Straaijer, and Van Schaik utilize oxygen, the oxygen reacts with another species. Alvarez is only directed toward cleaning gases, and has no teaching regarding whether oxygen reacts, or does not react, with other species in a method to remove contaminants. Thus, the references do not teach the an element of Claims 20 and 24. As well, Claim 20 is patentable for the same reasons that Claim 1 is patentable. Similarly, Claim 24 is patentable for the same reasons that Claim 12 is patentable.

Support for Claims 21 and 22 is found in paragraph **[0042]**, describing a "nominal concentration of 17 to 21% oxygen" and that purified air, having "less than 100 ppt contaminants" and "referred to as XCDA (extra clean dry air)," may be used. Claims 21 and 22 are patentable since none of the cited art address the use of a purified purge gas with the claimed oxygen concentrations of the new claims. As well, Claims 21 and 22 are patentable for the same reasons that Claim 12 is patentable.

Claim 23 is supported in the same manner as the amendment for Claim 1. Thus, new Claim 23 is also patentable for the same reasons that Claims 1 and 12 are patentable.

Claims 25 and 26 are supported at paragraph **[0046]** and the various examples of the application. The claims are patentable over the cited art for the same reasons that Claims 1 and

12 are patentable. In addition, none of the cited art is directed toward removing AMC from wafers.

F. Cancelled Claims 6, 7, 16, and 17

Claims 6, 7, 16, and 17 are cancelled to expedite prosecution of the present application. The cancellation is not an admission by the Applicants regarding the propriety of the Office Action's rejection of such claims. Applicants maintain the right to prosecute such claims at a later time.

G. Double Patenting

Claims 1-19 are provisionally rejected as being unpatentable over Claims 1-11 of copending, related U.S. Patent Application No. 10/683,904 for obviousness-type double patenting. Claim amendments to the current application and the related application separate the claims of each application such that each set is patentably distinct. The current application is drawn to methods of removing AMC that utilize a purified purge gas comprising oxygen. U.S. Patent Application No. 10/683,904 is drawn to methods of removing AMC that utilize water in the purified purge gas. The sets are patentably distinct because (i) each set is novel and unobvious; and (ii) the sets are patentable over one another. That is, the use of water in a purified purge gas does not render obvious the use of oxygen in a purified purge gas. The applications show that the behavior of the purge gases and the concentrations for optimal use are not necessarily the same.

Thus, Claims 1-19 are patentable over the claims of copending U.S. Patent Application No. 10/683,904.

Information Disclosure Statement

An Information Disclosure Statement (IDS) is being filed concurrently herewith. Entry of the IDS is respectfully requested.

CONCLUSION

In view of the above amendments and remarks, it is believed that all pending claims are in condition for allowance, and it is respectfully requested that the application be passed to issue. If the Examiner feels that a telephone conference would expedite prosecution of this case, the Examiner is invited to call the undersigned.

Respectfully submitted,

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Dated: 22 November 2004